GB03/2394 #2

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GB03/02394

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I also certify that by virtue of an assignment registered under the Patents Act 1977, the application is now proceeding in the name as substituted.

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Signed

Dated 9 July 2003

GB 0213069.8

By virtue of a direction given under Section 30 of the Patents Act 1977, the application is proceeding in the name of

STACEY OIL SERVICES LIMITED,
16 Albyn Place,
ABERDEEN,
AB9 1PS,
United Kingdom

Incorporated in the United Kingdom,

[ADP No. 08488694001]

Patents Form 1/77

Patents Act 1977
(Rule 16)

The Patent Office

1/77

08JUN02 E724138-4 D10002
P01/7700 0.00-0213069.8

THE PATENT OFFICE
07 JUN 2002
NEWPORT

Request for grant of a patent

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The Patent Office
Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference — sot.2323.uk.dk/ac.b

2. Patent application number *(The Patent Office will fill in this part)* — 0213069.8 — 07 JUN 2002

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

Stacey Oil Tools Limited
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SECTION 30(1977 ACT) APPLICATION FILED 9/10/02

8398612001

Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation — UK

4. Title of the invention — Rotating diverter head

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

Kennedys Patent Agency Limited
Floor 5, Queens House
29 St Vincent Place
GLASGOW
G1 2DT
United Kingdom

8058240002

Patents ADP number *(if you know it)*

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

Yes

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	
Description	12 ✓
Claim(s)	
Abstract	MSC
Drawing(s)	3 + 3

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature KENNEDYS — Date 6 June 2002

12. Name and daytime telephone number of person to contact in the United Kingdom

David Kennedy
tel: 0141 226 6826

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Rotating diverter head

The present invention relates equipment used in the drilling of oil, gas and geothermal wells and in particular, though not exclusively, to a rotating diverter head which includes an inlet flange on which the head can rotate to adjust the location of a side outlet.

In drilling a well, a drilling tool or "drill bit" is rotated under an axial load within a bore hole. The drill bit is attached to the bottom of a string of threadably connected tubulars or "drill pipe" located in the bore hole. The drill pipe is rotated at the surface of the well by an applied torque which is transferred by the drill pipe to the drill bit. As the bore hole is drilled, the hole bored by the drill bit is substantially greater than the diameter of the drill pipe. To assist in lubricating the drill bit, drilling fluid or gas is pumped down the drill pipe. The fluid jets out of the drill bit, flowing back up to the surface through the annulus between the wall of the bore hole and the drill pipe.

The density of the drilling fluid is adjusted such that the pressure head produced by the weight of the column of drilling fluid is slightly more or less than the pressure of the oil or gas encountered in the geological formations being drilled through. If the pressure head of the column of drilling fluid is greater than the pressure of the oil or gas, the top of the well can be open to atmosphere. It is often advantageous to allow the pressure head of the drilling fluid to be slightly less than the pressure of the oil or gas encountered in the formation. In this case, known as "underbalanced drilling", the annulus around the drill pipe needs to be sealed and the drilling fluid returning under pressure up the annulus must be diverted to a recirculating unit for pumping back down the well.

Rotating diverter heads provide a means of sealing off the annulus around the drill pipe as the drill pipe rotates and translates axially down the well while including a side outlet through which the return drilling fluid is diverted. Such rotating diverter heads may also be referred to as rotating blow out preventers or drilling heads. These units generally comprise a stationary housing or bowl including a side outlet for connection to a fluid return line and an inlet flange for locating the unit on a blow out preventer or other drilling stack at the surface of the well bore. Within the bowl, opposite the inlet flange, is arranged a rotatable assembly such as anti-friction bearings which allow the drill pipe, located through the head, to rotate and slide. The assembly includes a seal onto the drill pipe which is typically a strip of rubber.

Prior art rotatable diverter heads such as those disclosed in US Patent Nos. 4949796, 5662181, 5848643, 5647444, 4480703 and 4312404 have concentrated on improvements to the sealing means, in particular the ease to which the rubber strips can be replaced. In all these diverter heads the side outlet are included in the housing of the stationary bowl and the rotatable assemblies are mounted above the side outlet to aid disassembly for maintenance.

A disadvantage of these prior art diverter heads is that as the bowl is bolted or clamped to the blow out preventer, the side outlet is fixed at a single position. The pipework forming the return fluid line must attach to the side outlet and as both are generally fixed in position and orientation it is difficult to mate their respective flanges together.

It is therefore an object of the present invention to provide a rotating diverter head which can be rotated to re-position the side outlet with respect to the inlet flange.

It is a further object of the present invention to provide an improved method of connecting a rotating diverter head to a return fluid line at a blow out preventer.

According to a first aspect of the present invention there is provided a rotating diverter head comprising:

a bowl member having a first bore aligned on a central axis therethrough and a second bore located substantially transverse of the central axis;

a housing located substantially within the bowl member including first rotational means to rotate the housing relative to the bowl member and first sealing means to sealably engage the housing upon a drill pipe when the drill pipe is inserted through the first bore; and

an inlet flange for connecting the bowl member to a blow out preventer stack, the flange including second rotational means to selectively rotate the bowl member about the central axis.

By allowing the bowl member to rotate relative to the inlet flange and hence the blow out preventer stack, the second bore can be rotated on the central axis to aid alignment with a return flow line.

Preferably the second rotational means comprises interconnected screw threads between the flange and the bowl member.

Preferably also the flange further includes second sealing means to prevent the egress of fluid from the first bore through the second rotational means. The second sealing means may be an o-ring or other rubber based seal.

Preferably the flange further includes locking means for preventing rotational movement of the bowl member with respect to the flange when the second bore is aligned.

Advantageously the locking means comprises a locking ring arranged around the bowl member and engageable on the screw threads.

Preferably the housing including first sealing means and first rotational means is as known in the art. Examples of such housings are disclosed in US Patent Nos. 4949796, 5662181, 5848643, 5647444, 4480703 and 4312404, the contents of which are incorporated herein by reference.

According to a second aspect of the present invention there is provided a bowl for use in a rotatable diverter head, the bowl comprising a substantially cylindrical body having a bore there through adapted for receiving a housing, rotatable therein and sealable to a drill pipe passed there through, and an inlet flange, the body and flange being rotatably coupled such that the body rotates on a longitudinal axis of the bore when the flange is attached to a blow out preventer stack.

Preferably the body and flange are rotatably coupled by interconnected screw threads on an outer surface of the body and an inner surface of the flange.

Preferably also the flange further includes sealing means to prevent the egress of fluid from the bore through the rotational coupling. The sealing means may be an o-ring or other rubber based seal.

Preferably the flange further includes locking means for preventing rotational movement of the body with respect to the flange when the desired. Advantageously the

locking means comprises a locking ring arranged around the body and engageable on the screw threads.

According to a third aspect of the present invention there is provided a method of connecting a rotating diverter head to a return fluid line at a blow out preventer stack, the method comprising the steps:

(a) connecting an inlet flange of the diverter head to an outlet of the blow out preventer stack;

(b) rotating the diverter head with respect to the blow out preventer stack to align a side outlet of the head with a return fluid line; and

(c) connecting the side outlet to the return fluid line.

Advantageously the method includes the step of locking the diverter head in position to prevent rotation of the diverter head relative to the blow out preventer after the side outlet is aligned.

An example embodiment of the present invention will now be described, by way of example only, with reference to the accompanying drawings of which:

Figure 1 is an isometric view of a rotating diverter head according to an embodiment of the present invention;

Figure 2 is a cross sectional view taken vertically through the head of Figure 1;

Figure 3 is a side view of the head of Figure 1 mounted on the top of a blow out preventer stack; and

Figures 4 and 5 are top views of the head of Figure 1 illustrating first and second alignment positions of the side outlet.

Reference is initially made to Figures 1 and 2 illustrating a rotating diverter head, generally indicated by reference numeral 10, in accordance with an embodiment of the present invention.

Head 10 includes a bowl 11 which is generally a cylindrical body, a rotating spindle 12, an inlet flange 14 and a side outlet 16. Spindle 12 forms a housing which rotates in anti-friction bearings 18. Spindle 12 also includes a seal 20 which sealably engages a drill pipe 22 located through the head 10.

In the prior art diverter heads these features are found with the bowl and flange typically being of single piece construction and thus referred to as a stationary housing. As can be seen in Figure 2, the bowl 11 and flange 14 are separate pieces in the present invention. It is the arrangement of the flange 14 and bowl 11 which relate to the present invention and thus the spindle 12 together with its bearing 18 and sealing means 20 may be of any type as is known in the art. For clarity one embodiment of a spindle 12 will be described herein, however recognition that any arrangement of spindle 12 could be used with/in the present invention, will be appreciated.

In the embodiment shown, head 10 comprises a cylindrical body or bowl 11, located upon a flange 14. Bowl 10 has an outer surface 24 upon which are located lugs 26 for lifting and positioning the head 10 on a blow out preventer stack (not shown). Flange 14 has a base 28 compatible with the top flange of the blow out preventer stack and the two are linked via screws located in ports 30. The dimensions of the base 28 of the flange 14 are determined by an international standard to ensure proper mating with other flanges of the same size and pressure rating. Once positioned the flange 14 is fixed in relation to the blow out preventer stack. A seal groove 32 on the bottom face 34 of the base 28 provides for an o-ring to be inserted to prevent the egress of fluid from the head 10 between the base 28 and the blow out preventer stack.

The bowl 11 and flange 14 provide a bore 36 on a central axis 38 through the head 10. The side outlet 16 is arranged to direct fluid in a perpendicular direction from the central bore 36. The bowl 11 and the flange 14 mate between a respective inner surface 40 of the bowl 11 and an outer surface 42 of the flange 14. The inner surface 40 includes a threaded bore 44 and a sealing bore 46. The diameter of sealing bore 46 is less than the diameter of threaded bore 44. The outer surface 42 of flange 14 includes a threaded section 48 and a sealing section 50. The threads of threaded section 48 engage the threads of threaded bore 44 of bowl 11. The sealing section 50 comprises a seal groove 52 into which is located an o-ring or rubber strip (not shown). When the threads of the threaded bore 44 engage the threads on the threaded section 48, the sealing section 50 locates

against the sealing bore 46, thus providing sealing engagement between the bowl 11 and the flange 14 to prevent the egress of fluid from the head 10 at this location. The seal will be maintained as the threads are moved relative to each other so that the bowl 11 can rotate on the central axis 38 relative to the flange 14. This rotation is selective and continuous through 360 degrees around the central axis.

Located around the flange 14 is a locking ring 54. Ring 54 is a threaded lock ring which comprises a threaded inner surface 56 that engages threaded section 48 of flange 14. Ring 54 can be rotated upwards towards the base 58 of bowl 11 to prevent movement of the bowl 11 and thus lock the bowl 11 to the flange 14.

Toward an upper end 60 of bowl 11 is located a spindle 12 or housing. Spindle 12 includes a through bore 62 located on the central axis 38. A drill pipe 22 may extend axially through the bore 62. Spindle 12 includes a stripper 64 as is known in the art. Stripper 64 comprises a molded, resilient seal 20 having a through-hole 66 and a flange 68. The nominal diameter of through-hole 66 is somewhat smaller than the diameter of drill pipe 22 such that the inner surface 70 of the through-hole 66 sealably engages the outer diameter 72 of the drill pipe 22. Spindle 12 further comprises a carrier 74. Carrier 74 has a cylindrical body providing a through-hole 76 concentric to the central axis 38 and an outer surface 78. Flange 68 seals against the carrier 74. At the outer surface 78 of carrier 74 is located a bearing housing 80. Carrier 74 is sealably engaged to bearing housing 80. However, in one or more embodiments the carrier 74 may be disengageable

from the bearing housing 80 so that the seal 20 of the stripper 64 can be easily removed from the head 10 for maintenance or replacement. Housing 80 includes anti-friction bearing 18 which allow the bearing housing 80 to rotate within the bowl 11. By their engagement, when housing 80 rotates the stripper 64 and carrier 74 will rotate in a fixed relationship. Thus the spindle 12 can rotate within the bowl 11 while maintaining a seal against the drill pipe 22 passing there through. Thus the drill pipe 22 can rotate or reciprocate unheeded through the head 10. The seal 20 also ensures that fluid travelling up bore 36 is directed through the side outlet 16 for re-circulating down the drill pipe 22.

Reference is now made to Figures 3 through 5 which illustrate the rotating diverter head 10 in use. To operate, lock ring 54 is threaded onto threaded section 48 of flange 14. Flange 14 is threaded into bowl 11 until face 86 of flange 14 contacts face 88 of bowl 11. Lock ring 54 is threaded until it contacts the base 58 of bowl 11. The rotating diverter head 10 is mounted onto annular blowout preventer 82 of a stack (not shown) using lugs 26 to assist its movement. Head 10 is fixed to blow out preventer 82 by mating flange 14 to outlet flange connection 84 of annular blowout preventer 82 using threaded studs located through ports 30.

A return flow line 90 is attached to an outlet flange 92 of the side outlet 16, as is shown in Figures 3 and 5. Flow line 90 is typically a section of fixed piping connected to a separator (not shown). referring now to Figure 4, if flow line 90 is not aligned with outlet flange 92, i.e., if the axis 94 of flow line 90 is not

co-linear with the axis 96 of outlet flange 92, the head 10 must be rotated about the central axis 38 until the axis 96 of outlet flange 92 is co-linear with the axis 94 of flowline 90.

Rotating diverter head 10 is rotated about its vertical axis on the central axis 38 by unthreading lock ring 54, rotating bowl 11 on the threads of the threaded bore 44 against the threads of threaded section 48 of flange 14, until the axis 96 of outlet flange 92 is co-linear with the axis 94 of flowline 90. Lock ring 54 is then threaded upward and tightened against the base 58 of the bowl 11.

In prior art diverter heads the inlet flange is either welded or otherwise immovably and permanently attached to bowl. This means that the relationship between the inlet flange and the side outlet is fixed preventing movement of the side outlet to aid alignment with a return flow line. Therefore an advantage of the present invention is that it provides a rotating diverter head where the side outlet can be re-aligned when the head is connected to a blow out preventer.

A further advantage of the present invention is that it provides a diverter head in which the inlet flange may be interchangeable so that the size and pressure rating of the diverter head can be varied without the need to change the spindle.

Modifications may be made to the invention herein described without departing from the scope thereof. For example, the threaded bore and threaded section may be replaced by a pin and groove arrangement. The groove

being a spiral into which the pin may travel circumferentially around the inner or outer surface of the flange or bowl, respectively.

INFORMAL

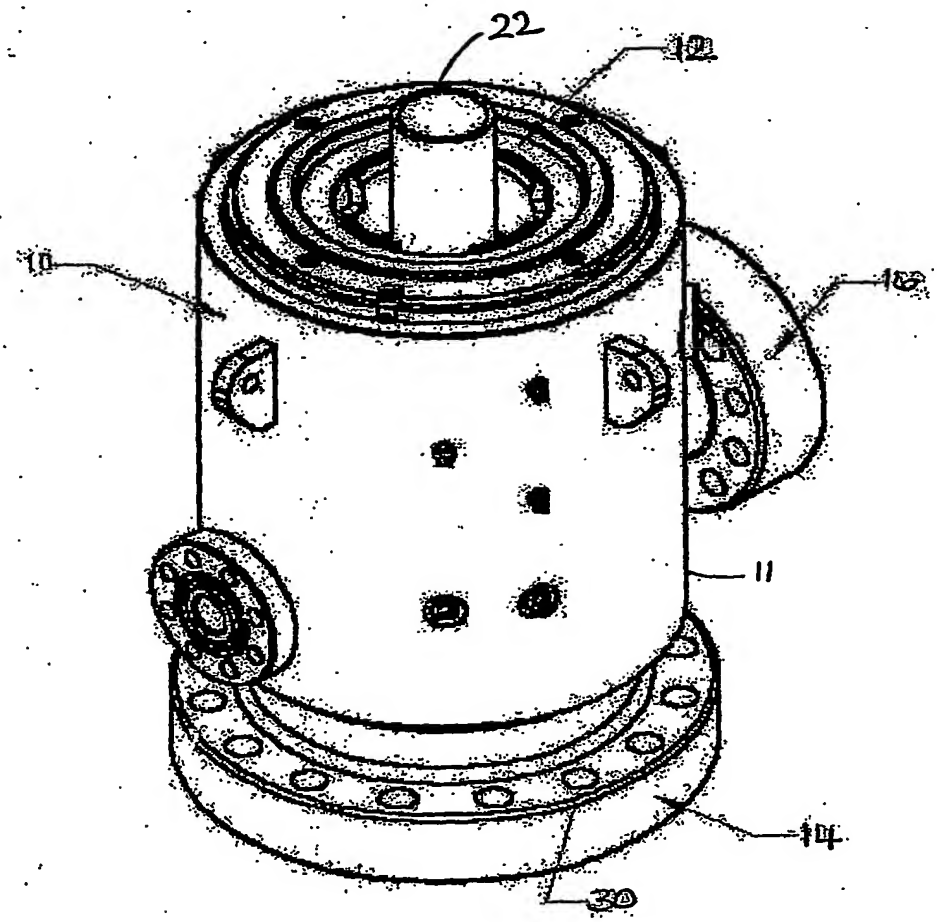

FIGURE 1

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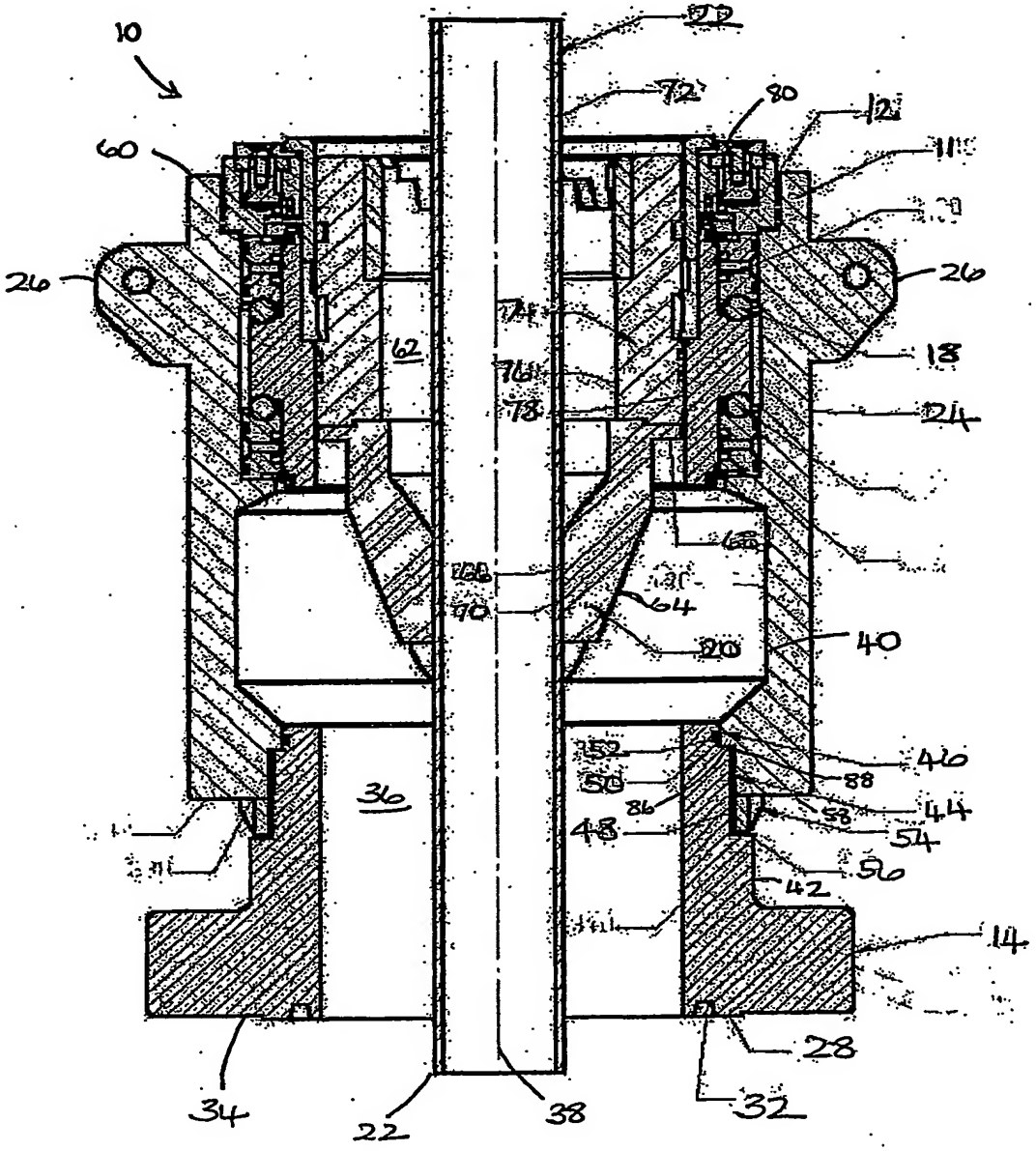

Figure 2

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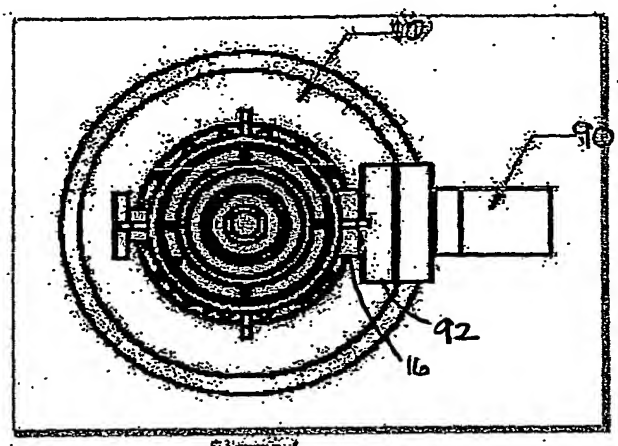

Figure 4

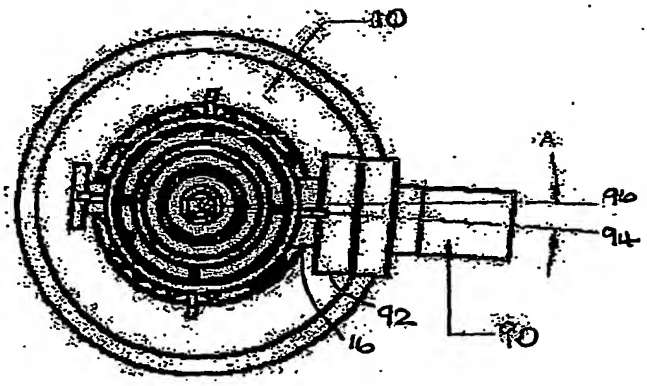

Figure 5

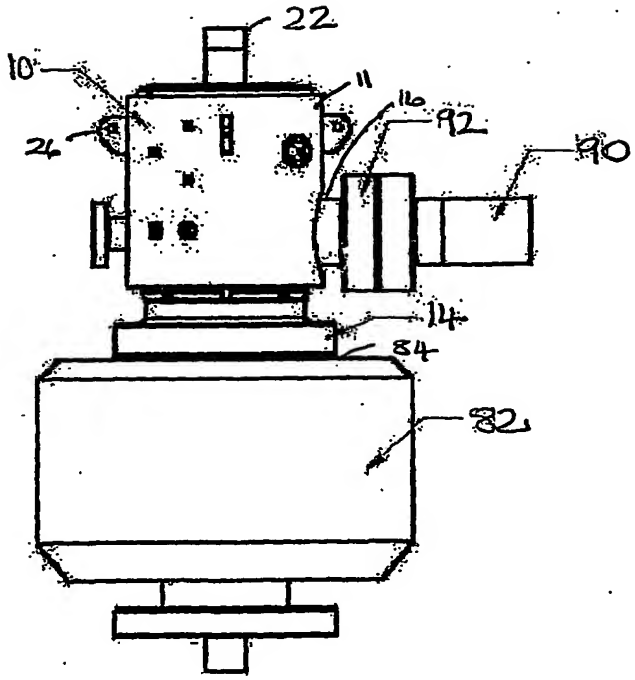

Figure 3